[redacted]

JC10 Rec'd PCT/PTO 25 FEB 2002

FORM PTO-1390 (REV. 9-2001) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY 'S DOCKET NUMBER: P/3240-67

U.S. APPLICATION NO. (If known, see 37 CFR 1.5: 10/069611

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/06930	20 July 2000	24 August 1999

TITLE OF INVENTION: METHOD OF OPERATING A FUSION GASIFIER

APPLICANT(S) FOR DO/EO/US: Rainer-Walter KASTNER

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [ ] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [X] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   - b. [X] has been communicated by the International Bureau.
   - c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   - a. [X] is attached hereto.
   - b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [ ] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   - b. [ ] have been communicated by the International Bureau.
   - c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   - d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). - unsigned
10. [X] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). (Claims 5 - 9)

Items 11 to 20 below concern document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordan
18. [ ] A second copy of the published international application und
19. [ ] A second copy of the English language translation of the inte
20. [X] Other items or information:
    Print PEFS form. Postcard.
    13 References.
    1 sheet of drawings.

EXPRESS MAIL CERTIFICATE

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail Post Office Addressee (Mail Label EL 924374090 US) in an envelope addressed to: U.S. Patent and Trademark Office, PO Box 2327, Arlington, VA 22202, on Feb. 25, 2002

Dorothy Jenkins
Name of Person Mailing correspondence

Dorothy Jenkins
Signature

February 25, 2002
Date of Signature

10/069611 ~~JC19 Rec'd PCT/PTO~~
JC19 Rec'd PCT/PTO 25 FEB 2002

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 10/069611	INTERNATIONAL APPLICATION NO. PCT/EP00/06930	ATTORNEY'S DOCKET NUMBER P/3240-67

21. [x] The following fees are submitted:	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	11 - 20 =	0	x **$18.00**	$	
Independent claims	1 - 3 =	0	x **$84.00**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$280.00**	$	

TOTAL OF ABOVE CALCULATIONS =	$ 1040.00	
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. +	$	
SUBTOTAL =	$ 1040.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).	$	
TOTAL NATIONAL FEE =	$ 1040.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +	$	
TOTAL FEES ENCLOSED =	$ 1040.00	
	Amount to be refunded:	$
	charged:	$

a. [x] A check in the amount of $ 1040. to cover the above fees is enclosed. **Check No.** 8542

b. [ ] Please charge my Deposit Account No. ____________ in the amount of $ __________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 15-0700 . A duplicate copy of this sheet is enclosed.

d. [ ] Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

OSTROLENK, FABER, GERB & SOFFEN, LLP
1180 Avenue of the Americas
New York, NY 10036-8403

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[signature]
SIGNATURE

Robert C. Faber
NAME

24,322
REGISTRATION NUMBER

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P/3240-67

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

Rainer-Walter KASTNER et al — Date: February 25, 2002

Serial No.: — Group Art Unit:

Filed: — Examiner:

For: METHOD OF OPERATING A FUSION GASIFIER

U.S. Patent and Trademark Office
P.O. Box 2327
Arlington, VA 22202

Attn: Box PCT (US/DO/EO)

AMENDMENT/SUBMISSION

Prior to examination, please amend the application as follows.

FEE CALCULATION

Any additional fee required has been calculated as follows:

_____ If checked, "Small Entity" status is claimed.

	NO. CLAIMS AFTER AMENDMENT		HIGHEST NO. PREVIOUSLY PAID FOR		EXTRA PRESENT		RATE	ADDIT. FEE
TOTAL	11	MINUS	20	* =	0	X	($9 SE or $18)	$
INDEP.	2	MINUS	3	** =	0	X	($42 SE or $84)	$
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM						X	($140 SE or $280)	$
* not less than 20 ** not less than 3							TOTAL	$ -------

If any additional payment is required, a check which includes the calculated fee of $____ (OFGS Check No. ______) is attached.

In the event the actual fee is greater than the payment submitted or is inadvertently not enclosed or if any additional fee during the prosecution of this application is not paid, the Patent Office is authorized to charge the underpayment to Deposit Account No. 15-0700.

CONTINGENT EXTENSION REQUEST

If this communication is filed after the shortened statutory time period had elapsed and no separate Petition is enclosed, the Commissioner of Patents and Trademarks is petitioned, under 37 C.F.R. § 1.136(a), to extend the time for filing a response to the outstanding Office Action by the number of months which will avoid abandonment under 37 C.F.R. § 1.135. The fee under 37 C.F.R. § 1.17 should be charged to our Deposit Account No. 15-0700.

AMENDMENTS

_X_ If checked, amendment(s) to the specification and/or claims are submitted herewith.

1. ___ If checked, an abstract is submitted as the last page of Appendix A.

2. Claims:

Please amend claims 3-6 and 9-11 pursuant to 37 C.F.R. § 1.121(c)(i) as set forth in the "clean" version attached hereto as Appendix A. Entry is respectfully requested. A version with markings to show the changes made pursuant to 37 C.F.R. § 1.121(c)(ii) is attached hereto as Appendix B.

___ If checked, the optional complete set of "clean" claims pursuant to 37 C.F.R. § 1.121(c)(3) is attached hereto as Appendix C.

REMARKS/ARGUMENT

This Preliminary Amendment is being submitted to change the multiple dependent claims to single dependent claims in order to eliminate the improper multiple dependent claims and to reduce the government filing fee.

EXPRESS MAIL CERTIFICATE

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Dorothy Jenkins
Name of Person Mailing Correspondence

Dorothy Jenkins
Signature

February 25, 2002
Date of Signature

Respectfully submitted,

Robert C. Faber

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APPENDIX A

"CLEAN" VERSION OF EACH PARAGRAPH/SECTION/CLAIM
37 C.F.R. § 1.121(b)(ii) AND (c)(i)

CLAIMS (with indication of amended or new):

(Amended) 3. Method according to Claim 1, characterized in that a characteristic variable representative of the gas flow, in particular the volume flow and if required the pressure, is measured in a number of the gas lines and, if there is a deviation from a prescribed setpoint value, the pressure of the oxygen-containing gas in the respective gas line is increased or reduced.

(Amended) 4. Method according to Claim 1, characterized in that, when tapping is performed on the fusion gasifier, the supply of oxygen-containing gas to oxygen nozzles located in the region above the tapping opening is throttled, in order to ensure an adequate tapping length.

(Amended) 5. Method according to Claim 1, characterized in that, when tapping is performed on the fusion gasifier, the supply of oxygen-containing gas to oxygen nozzles located in the region above the tapping opening is increased in order to reduce an excessive tapping length.

(Amended) 6. Method according to Claim 1, characterized in that, when shutting down the fusion gasifier, the supply of oxygen-containing gas to oxygen nozzles far away from the tapping opening is initially throttled or stopped.

(Amended) 9. Fusion gasifier (1) according to Claim 7, characterized in that a nitrogen supply line (23) opens out into the gas line (16) upstream or downstream of the regulating device (21) in a number of gas lines (16).

(Amended) 10. Fusion gasifier (1) according to Claim 7, characterized in that the regulating device (21) is arranged directly upstream of the oxygen nozzle (8) in the direction of gas flow in a number of gas lines (16).

(Amended) 11. Fusion gasifier (1) according to Claim 7, characterized in that measuring devices (18) for sensing the pressure and/or the volume flow of the oxygen-containing gas and for supplying corresponding actual signals to a controlling device (19) are arranged in a number of gas lines (16), it being possible for setpoint values (20) for pressure and/or volume flow in the gas lines (16) to be fed from outside to the controlling device (19) and for the regulating devices (21) to be controlled by the controlling device (19), separately from one another in each case, in dependence on a setpoint/actual-value comparison.

APPENDIX B
VERSION WITH MARKINGS TO SHOW CHANGES MADE
37 C.F.R. § 1.121(b)(iii) AND (c)(ii)

CLAIMS:

3. Method according to [either of Claims 1 and 2] Claim 1, characterized in that a characteristic variable representative of the gas flow, in particular the volume flow and if required the pressure, is measured in a number of the gas lines and, if there is a deviation from a prescribed setpoint value, the pressure of the oxygen-containing gas in the respective gas line is increased or reduced.

4. Method according to [one of Claims 1 to 3] Claim 1, characterized in that, when tapping is performed on the fusion gasifier, the supply of oxygen-containing gas to oxygen nozzles located in the region above the tapping opening is throttled, in order to ensure an adequate tapping length.

5. Method according to [one of Claims 1 to 3] Claim 1, characterized in that, when tapping is performed on the fusion gasifier, the supply of oxygen-containing gas to oxygen nozzles located in the region above the tapping opening is increased in order to reduce an excessive tapping length.

6. Method according to [one of Claims 1 to 3] Claim 1, characterized in that, when shutting down the fusion gasifier, the supply of oxygen-containing gas to oxygen nozzles far away from the tapping opening is initially throttled or stopped.

9. Fusion gasifier (1) according to [one of Claims 7 or 8] Claim 7, characterized in that a nitrogen supply line (23) opens out into the gas line (16) upstream or downstream of the regulating device (21) in a number of gas lines (16).

10. Fusion gasifier (1) according to [one of Claims 7 to 9] Claim 7, characterized in that the regulating device (21) is arranged directly upstream of the oxygen nozzle (8) in the direction of gas flow in a number of gas lines (16).

11. Fusion gasifier (1) according to [Claims 7 to 10] Claim 7, characterized in that measuring devices (18) for sensing the pressure and/or the volume flow of the oxygen-containing gas and for supplying corresponding actual signals to a controlling device (19) are arranged in a number of gas lines (16), it being possible for setpoint values (20) for pressure and/or volume flow in the gas lines (16) to be fed from outside to the controlling device (19) and for the regulating devices (21) to be controlled by the controlling device (19), separately from one another in each case, in dependence on a setpoint/actual-value comparison.

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Method of operating a fusion gasifier

The invention relates to a method of operating a fusion gasifier in which iron-containing charge materials, such as partly and/or fully reduced iron sponge, are fully reduced, if required, and are fused, with the addition of solid carbon carriers and the supply of an oxygen-containing gas - via a multiplicity of oxygen nozzles distributed around the circumference of the fusion gasifier - in a fixed bed formed from the solid carbon carriers, to form liquid pig iron or a primary steel product with the simultaneous formation of a CO- and H_2-containing reduction gas, the oxygen-containing gas being passed via gas lines to the oxygen nozzles, from where the oxygen-containing gas is blown into the fixed bed. The invention also relates to a fusion gasifier for carrying out the method according to the invention.

In fusion gasifiers of the type mentioned above, the supplying of the oxygen-containing gas takes place via a supply line to a bustle pipe surrounding the fusion gasifier. From this bustle pipe, the oxygen-containing gas is distributed via supply lines to the oxygen nozzles fitted on the circumference of the fusion gasifier and is blown into the fusion gasifier or the fixed bed formed in it from the solid carbon carriers.

During the operation of the fusion gasifier, permeability fluctuations of the fixed bed occur, hindering or preventing gas, and consequently energy input, from taking place uniformly around the circumference. This causes the gas flow to be divided unevenly among the individual oxygen nozzles, with corresponding disadvantageous effects on the fusion gasifying process.

Since, in a fusion gasifier of solid carbon carriers a reduction gas, and consequently also the energy required for the melting of the iron sponge, is obtained by gasifying by means of oxygen-containing gas, the supplying of the oxygen-containing gas also

always involves supplying energy. Thus, "supplying energy" or "energy input" is understood here as meaning the supplying or blowing of the oxygen-containing gas into the fusion gasifier.

If the permeability fluctuations mentioned above become so strong that brief interruptions in the gas flow through individual nozzles occur, liquid slag and/or liquid pig iron can penetrate into the drilled channels arranged downstream - referring to the usual oxygen gasflow - of the oxygen nozzles or up to the oxygen nozzles themselves and, as a result, block the gas flow and damage the oxygen nozzles. Such operational problems often require shutting down of the fusion gasifier in order to repair nozzles which are blocked with slag or damaged.

In DE 37 42 156 C1 there is disclosed a method of operating a fusion gasifier in which, in the event of the supply of oxygen failing or being reduced, blocking or damaging of the nozzles is prevented by any remaining supply of oxygen being stopped and an inert gas being blown instead into the fusion gasifier via the oxygen nozzles.

Although this method is suitable for mitigating the further adverse consequences, that is damage to the oxygen nozzles, when an operational problem has in any case occurred, it is not possible to prevent slag build-ups and damage from being caused by permeability fluctuations during "proper" operation.

It is therefore the object of the invention to provide a method of operating a fusion gasifier and a corresponding fusion gasifier in which the slag build-ups and damage to oxygen nozzles occurring during operation are prevented. As a result, the method should require fewer operational shutdowns overall and consequently permit greater production and save costs.

According to the invention, the set object is achieved in the case of a method of the type described at the beginning by the supply of oxygen-containing gas to the oxygen nozzles being regulated in a number of

the gas lines in order to set a prescribed volume or mass flow of the oxygen-containing gas in the number of gas lines, or the oxygen nozzles corresponding to them.

By means of the method according to the invention it is possible for the first time to regulate individually each individual flow of the oxygen-containing gas to the oxygen nozzles and to have a selective influence on the gas distribution in the fusion gasifier.

Until now, the pressure prevailing in the supply line upstream of the bustle pipe, of approximately 8 bar, has been throttled by means of a flow regulating member to a bustle pipe pressure of approximately 5 bar, which is the pressure that then also prevails in the gas lines to the oxygen nozzles and at the oxygen nozzles themselves. The operating pressure of the fusion gasifier is approximately 4 bar, so that the pressure drop at the nozzle is only approximately 1 bar.

With the method according to the invention, it is now no longer necessary to reduce the pressure upstream of the bustle pipe, so that the high supply pressure of 8 bar now also prevails in the bustle pipe, and is then only throttled to 5 bar directly upstream of each oxygen nozzle. The pressure drop at the nozzles is still approximately 1 bar.

These statements initially apply only in the case of a uniformly gas-permeable fixed bed. As long as no permeability fluctuations of the fixed bed occur, the supply of oxygen-containing gas is evenly distributed over the circumference of the fusion gasifier.

If the gas-permeability problems described occur, it is possible with the method according to the invention to counteract them by reducing the pressure - depending on the particular desired flow rate - in the respective gas line to a greater or lesser degree, for example from 8 to 5 or to only 6 bar. While a variation of the pressure has in previous methods

always applied to all the oxygen nozzles and permeability fluctuations of the fixed bed in the circumferential direction of the fusion gasifier caused the overall oxygen - and consequently the energy input to the individual oxygen nozzles - to be divided unevenly, the solution according to the invention for the first time allows the oxygen input to be influenced locally and ensure that it is evenly divided by the individual flow regulation.

According to an advantageous embodiment of the method according to the invention, the regulation of the supply of oxygen-containing gas to each of the oxygen nozzles thus takes place in dependence on the pressure conditions prevailing in the fusion gasifier, these pressure conditions - with respect to the oxygen nozzles - being determined by the respective permeability of the fixed bed, or fluctuations thereof. This regulation preferably takes place by the supply of the oxygen-containing gas to the oxygen nozzles affected by the respective fluctuations being reset to a prescribed volume or mass flow.

Regulating intervention expediently takes place only for the nozzles affected by the respective permeability fluctuations.

In particular, the procedure followed here is that a characteristic variable representative of the gas flow, in particular the volume flow and if required the pressure, is measured in a number of the gas lines. If there is a deviation from a prescribed setpoint value, as described above, the pressure in the respective gas line is correspondingly regulated and consequently the desired gas flow is reset.

The method according to the invention is also suitable for ensuring when there are tapping problems proper tapping of liquid pig iron and liquid slag.

For this purpose, when tapping is performed on the fusion gasifier, the supply of oxygen-containing gas to the oxygen nozzles located in the region of the tapping opening or above the tapping opening is

throttled in order to ensure an adequate tapping length.

As an alternative to this, or depending on the respective problem during tapping, the supply of oxygen-containing gas to the oxygen nozzles located in the region of the tapping opening or above the tapping opening is increased in order to reduce an excessive tapping length.

The method according to the invention is also suitable for minimizing the loss of bed during tapping after stopping charging when the fusion gasifier is shut down. For this purpose, the supply of oxygen-containing gas to oxygen nozzles far away from the tapping opening is initially throttled or stopped.

When supplying oxygen in the way according to the prior art, oxygen nozzles keep being blocked and damaged by penetrating liquid pig iron or liquid slag during scheduled shutdowns of the fusion gasifier.

The method according to the invention also reliably avoids such problems, in that the supply of oxygen-containing gas to individual oxygen nozzles is throttled in stages and/or continuously when the fusion gasifier is shut down. The permeability fluctuations of the fixed bed, occurring more frequently when the fusion gasifier is shut down than otherwise, are reliably counteracted by the method according to the invention being further applied.

The invention also relates to a fusion gasifier with charging devices for solid carbon carriers, such as lump coal, and iron-containing charge materials, such as partly and/or fully reduced iron sponge, with a fusion gasifying zone, which contains a fixed bed formed by the solid carbon carriers and the iron-containing charge materials, with a lower portion for receiving liquid pig iron or primary steel product and liquid slag, with a run-off for liquid slag and liquid pig iron, with a multiplicity of oxygen nozzles, which are arranged in the shell of the fusion gasifier, with a bustle pipe, which annularly surrounds the shell of

the fusion gasifier and from which oxygen-containing gas can be supplied to the oxygen nozzles via gas lines, and with a supply line for oxygen-containing gas, which opens out into the bustle pipe.

Such a fusion gasifier is characterized according to the invention in that a regulating device for regulating the volume flow of the oxygen-containing gas is arranged in a number of gas lines.

This arrangement of the regulating devices according to the invention is outstandingly suitable for achieving the object set according to the invention, but further advantages are also obtained.

According to the prior art, the oxygen supply is regulated by means of a single regulating valve in the supply line to the bustle pipe. To cope with the large amounts of gas and high gas pressures, this valve must be correspondingly designed and is obtainable only as a specially made part. Furthermore, the noise produced when reducing the pressure from 8 to 5 bar is so bad that it may be harmful to the health of plant personnel.

It has been found that, when smaller regulating devices, obtainable as mass-produced parts, are used, costs that are comparable overall are incurred - in spite of the large number of these devices (about 20 to 30) - and in particular the noise nuisance is reduced significantly.

It is particularly advantageous if, as according to a preferred embodiment, a regulating device for regulating the volume flow of the oxygen-containing gas is arranged in each of the gas lines.

To make it possible that individual nozzles can be switched over from oxygen to nitrogen during operation, a nitrogen supply line expediently opens out into the gas line upstream or downstream of the regulating device in a number of gas lines.

Consequently, individual nozzles can be activated or deactivated sequentially and with different amounts of oxygen or nitrogen when the fusion

gasifier is shut down or started up. As a result, a plant can be started up with a high system pressure, low amounts of oxygen and nevertheless oxygen outlet velocities that are adequate right from the outset.

It is also of advantage if the regulating device is arranged directly upstream of the oxygen nozzle in the direction of gas flow in a number of gas lines.

This has the result - in the event of the liquid phase penetrating into the nozzle channel - of providing a correction of the oxygen flow that is particularly rapid and restricted to the nozzle concerned and a particularly rapid gas pressure build-up. This pressure build-up forces the liquid phase back and consequently prevents or minimizes the damage.

According to a preferred embodiment of the fusion gasifier according to the invention, measuring devices for sensing the pressure and/or the volume flow of the oxygen-containing gas and for supplying corresponding actual signals to a controlling device are arranged in a number of gas lines, it being possible for setpoint values for the pressure and/or volume flow in the gas lines to be fed to the controlling device and for the regulating devices to be controlled by the controlling device, separately from one another in each case, in dependence on a setpoint/actual-value comparison.

The fusion gasifier according to the invention is explained in more detail below on the basis of the embodiment represented in Figure 1 of the drawing.

Figure 1 shows a vertical section through a fusion gasifier 1, which is charged from above with solid carbon carriers 4 and iron-containing charging materials 5 by means of charging devices 2, 3. The carbon carriers 4 are preferably formed by lump coal and/or coke and/or coke briquettes, the iron-containing charging materials are preferably formed by partly and/or fully reduced iron sponge in the form of lumps or fine particles.

Arranged over the fusion gasifier 1 there is usually a reduction unit, for example a direct reduction shaft, in which iron-oxide-containing material is reduced by means of the reduction gas generated in the fusion gasifier 1 to form the partly and/or fully reduced iron sponge. This iron sponge is transported out of the reduction shaft and fed to the fusion gasifier 1.

In the fusion gasifying zone 6 of the fusion gasifier 1 there forms a fixed bed 7, formed by the solid carbon carriers 4. An oxygen-containing gas, preferably industrial oxygen, as obtained for example from an air-separation plant, is blown into this fixed bed 7 via oxygen nozzles 8. In this case, the iron-containing charge materials 5 are melted to form liquid pig iron 9 and liquid slag 10, while at the same time forming a reduction gas. The reduction gas formed is drawn off from the fusion gasifier via a reduction-gas discharge line 11.

Liquid pig iron 9 and liquid slag accumulate in a lower portion 12 of the fusion gasifier 1 and are tapped via a run-off 13.

Oxygen-containing gas is supplied initially via a supply line 14 to a bustle pipe 15 annularly surrounding the fusion gasifier 1. From the bustle pipe 15, the oxygen nozzles 8 are fed via gas lines 16.

The oxygen nozzles 8 are in this case arranged in the outer region of the shell 17 of the fusion gasifier 1 and are connected to the interior of the fusion gasifier 1 via a drilled channel.

Altogether approximately 20 to 30 oxygen nozzles 8 are arranged in the circumference of the fusion gasifier 1, respectively spaced apart more or less evenly from one another and arranged essentially at the same height, so that the oxygen-containing gas is blown obliquely downwards into the lower region of the fixed bed 7.

Provided in each of the gas lines 16 is a measuring device 18 for measuring the pressure and/or

volume flow of the oxygen-containing gas. Corresponding measuring signals are supplied to a controlling device 19, which can be fed at least a setpoint value 20 for the volume flow.

In a fusion gasifier with a production of, for example, 100 t of pig iron/h, a consumption of 100 t of coal/h, 26 oxygen nozzles and an admission pressure prevailing at the oxygen nozzles of 5 bar, the setpoint volume-flow value through each of the gas lines 16 is, for example, approximately 1600 Nm^3/h.

Respectively arranged upstream of the measuring device 18 in each of the gas lines 16 is a regulating device 21, for example a valve or an adjustable flap.

If the measured volume flow deviates from the prescribed setpoint value, the desired volume flow is reset by the controlling device 19 by means of the regulating device 21.

The supply of oxygen-containing gas is regulated in a way according to the prior art by means of the valve 22 represented by dashed lines in the drawing.

For switching over from blowing in oxygen to blowing in nitrogen, a nitrogen supply line 23 is arranged directly downstream of the regulating device 21 in one of the gas lines 16.

The invention is not restricted to the exemplary embodiment represented in Figure 1, but instead also comprises all means known to a person skilled in the art that can be used for carrying out the invention.

For example, nitrogen supply lines 23 may open out into some or all of the gas lines 16 upstream or downstream of the regulating device 21.

Where they have not already been described above, further effects and advantages of the method according to the invention, as well as the fusion gasifier according to the invention, are also presented below.

Correction of permeability deviations:

The local adaptation of the amount of oxygen is used for changing the amount of gas generated in this area when gasifying the carbon carriers. The resultant changing of the gas velocities in the feedstock can correct and eliminate permeability problems such as gas channels, fluidized zones, etc.

In addition, an individual adaptation of the depth of penetration takes place in parallel with this. With the system pressure remaining the same, the depth of penetration of the oxygen jet into the bed, and consequently the energy density and gas distribution in an area directly around the nozzle, can consequently be locally adapted in a way corresponding to the permeability problems that have occurred.

- Energy input

- Local adaptation of the energy input

Inhomogeneous charging, such as for example adaptation of the discharge output of the iron-sponge screws to the shaft conditions, failure of an iron-sponge screw, segregation effects, etc., cause an energy requirement in the fusion gasifier that differs locally. With the individual regulation of the amount of oxygen to the nozzles, the energy requirement and energy input can be made to match each other locally.

- Correction of different nozzle geometries

It may be advisable to set local deviations of the energy input on a long-term basis in various areas of the fusion gasifier. To maintain the optimum oxygen outlet velocity, in this case nozzles with an adapted oxygen channel diameter are used. For example, nozzles with a smaller channel are often installed in the tapping area, in order to permit the build-up of a

stable, large tapping length by the lower energy input. In the event of operational problems, it may be necessary to adapt the reduced energy input. With the individual regulation of the amount of oxygen, this can be carried out reversibly at any time without nozzle changes and the associated downtime.

- Formation of deposits above the ring of nozzles

In the area of the melt phases above the ring of nozzles, the gasifier cooling system causes the formation of deposits. On the one hand, these deposits are desired to protect the masonry and cooling system, on the other hand process-related problems can occur if they are formed excessively. By locally adapting the energy input (amount, depth of penetration), the position of the temperature profile can be selectively influenced. Problematical deposits on the one hand can be melted away, protective layers on the other hand can be selectively built up.

- Metallurgical load on the furnace

The period of a campaign is determined essentially by the durability of the masonry in the furnace. Long service lives can be achieved only by "self lining". Advanced wear and loss of the self lining are demonstrated by thermocouples and in the tapping area by regression of the tapping length. In a way similar to controlling deposits above the nozzles, protective layers can be built up or preserved in critical areas by local adaptation of the energy input. On the other hand, inactive areas of the furnace may be re-activated by a locally increased energy input. For example, when the furnace is cold, the front region directly above the run-off that is particularly important for the removal of the liquid phase can be used to a greater extent.

- Tapping problems

- Build-up/reduction of the tapping length

In the tapping area, the liquid flow causes increased wearing of the masonry, generally compensated by pressing in tap-hole composition. If shortening of the tapping length nevertheless occurs, the metallurgical load on the furnace can be locally reduced by reducing the energy input via the front nozzles, helping to build up an adequate tapping length. Excessive tapping lengths, which hinder the outlet of the liquid phase, can be reduced by increasing the energy input in the tapping area.

- Reduction of the gas pressure in the tapping area

Excessive gas outlet in the tapping area disturbs the uniform, controlled and steady outlet of liquid and causes critical refractory damage. In extreme cases, operation of the plant can no longer be maintained. Gas compounds build up with preference in the area of the "Brustformen" (oxygen nozzles above the run-off) to the run-off. By selectively cutting back the amount of oxygen to the nozzles concerned, the gas pressure at the run-off can be reduced.

- Nozzle damage

A frequent reason for nozzle damage is the penetration of the liquid phase into the oxygen channel. As a result, the liquid pressure upstream of the nozzles must be able to force back the emerging oxygen jet, at least for a short time.

- Maintaining the inlet pulse when there are permeability problems

Permeability problems of the bed or high liquid pressure upstream of nozzles cause the amount of oxygen of the nozzles concerned and consequently the inlet pulse to be reduced. These nozzles become more susceptible to the inlet of liquid phases into the oxygen channel. With the individual regulation, the amount of oxygen per nozzle is corrected independently of the state upstream of the nozzles; as a result, the inlet pulse remains largely unchanged.

- Controlling the amount of oxygen when the oxygen channel widens

If, after penetrating into the nozzle, the liquid phase is forced back again by the oxygen jet, the oxygen channel usually has larger dimensions than desired. As a result, when regulated altogether, the amount of oxygen via the damaged nozzle increases. When regulated individually, the amount can be adapted to the requirements of the process, independently of the form taken by the damage.

- Drainage of the liquid phase

If the bed has an inadequate voids fraction, undesired accumulation of the liquid phase may occur in the area above the oxygen nozzles. This liquid phase can be drained more easily into the furnace beneath the nozzles by cutting back the amount of oxygen locally, for a limited time, possibly on a cyclical basis, and consequently cutting back the amount of gas acting against the flowing away of the liquid phase.

If the drainage beneath the nozzles is inadequately ensured locally, reduction of the amount of oxygen can reduce the loading of this area with the liquid phase and consequently prevent nozzle damage and

operational problems.

- Bed hangers

In gas/feedstock countercurrent reactors, material flow problems ("hangers") are known when critical parameters (gas velocity, particle spectrum, etc.) are exceeded. It is conceivable for hangers of this type to occur in the bed above the nozzles, leading to considerable inhomogeneities in the gas permeation, uneven sinking of the bed and consequently an unstable process. Cutting back the amount of oxygen locally, for a limited time, possibly on a cyclical basis, can reduce the amount of gas generated to the extent that the occurrence of hangers is eliminated at an early stage and major process-related problems can be avoided.

- Water/steam injection

One possible way of setting the temperature profile upstream of the nozzles is water/steam injection. According to process conditions, the amount of water/steam can be divided among individual nozzles evenly or individually. With the individual regulation of the amount of oxygen, the energy input can correspondingly be matched to the water/steam injection rate.

Patent claims

1. Method of operating a fusion gasifier in which iron-containing charge materials, such as partly and/or fully reduced iron sponge, are fully reduced, if required, and are fused, with the addition of solid carbon carriers and the supply of an oxygen-containing gas - via a multiplicity of oxygen nozzles distributed around the circumference of the fusion gasifier - in a fixed bed formed from the solid carbon carriers, to form liquid pig iron or a primary steel product with the simultaneous formation of a CO- and H_2-containing reduction gas, the oxygen-containing gas being passed via gas lines to the oxygen nozzles, from where the oxygen-containing gas is blown into the fixed bed, characterized in that the supply of the oxygen-containing gas to the oxygen nozzles is regulated individually in a number of the gas lines in order to set a prescribed volume or mass flow of the oxygen-containing gas in the number of gas lines, or the oxygen nozzles corresponding to them.

2. Method according to Claim 1, characterized in that, when there are local permeability fluctuations of the fixed bed within the fusion gasifier and resultant pressure and flow fluctuations in individual gas lines, the supply of the oxygen-containing gas to the oxygen nozzles affected by the respective fluctuations is reset to a prescribed volume or mass flow.

3. Method according to either of Claims 1 and 2, characterized in that a characteristic variable representative of the gas flow, in particular the volume flow and if required the pressure, is measured in a number of the gas lines and, if there is a deviation from a prescribed setpoint value, the pressure of the oxygen-containing gas in the respective gas line is increased or reduced.

4. Method according to one of Claims 1 to 3, characterized in that, when tapping is performed on the fusion gasifier, the supply of oxygen-containing gas to

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oxygen nozzles located in the region above the tapping opening is throttled, in order to ensure an adequate tapping length.

5. Method according to one of Claims 1 to 3, characterized in that, when tapping is performed on the fusion gasifier, the supply of oxygen-containing gas to oxygen nozzles located in the region above the tapping opening is increased in order to reduce an excessive tapping length.

6. Method according to one of Claims 1 to 3, characterized in that, when shutting down the fusion gasifier, the supply of oxygen-containing gas to oxygen nozzles far away from the tapping opening is initially throttled or stopped.

7. Fusion gasifier (1) with charging devices (2, 3) for solid carbon carriers (4), such as lump coal, and iron-containing charge materials (5), such as partly and/or fully reduced iron sponge, with a fusion gasifying zone (6), which contains a fixed bed (7) formed by the solid carbon carriers (4) and the iron-containing charge materials (5), with a lower portion (12) for receiving liquid pig iron (9) or primary steel product and liquid slag (10), with a run-off (13) for liquid slag (10) and liquid pig iron (9), with a multiplicity of oxygen nozzles (8), which are arranged in the shell (17) of the fusion gasifier (1), with a bustle pipe (15), which annularly surrounds the shell (17) of the fusion gasifier (1) and from which oxygen-containing gas can be supplied to the oxygen nozzles (8) via gas lines (16), and with a supply line (14) for oxygen-containing gas, which opens out into the bustle pipe (15), characterized in that a measuring device (18) for sensing and a corresponding regulating device (21) for regulating the volume flow of the oxygen-containing gas are arranged in a number of gas lines (16).

8. Fusion gasifier (1) according to Claim 7, characterized in that a regulating device (21) for

regulating the volume flow of the oxygen-containing gas is arranged in each of the gas lines (16).

9. Fusion gasifier (1) according to one of Claims 7 or 8, characterized in that a nitrogen supply line (23) opens out into the gas line (16) upstream or downstream of the regulating device (21) in a number of gas lines (16).

10. Fusion gasifier (1) according to one of Claims 7 to 9, characterized in that the regulating device (21) is arranged directly upstream of the oxygen nozzle (8) in the direction of gas flow in a number of gas lines (16).

11. Fusion gasifier (1) according to Claims 7 to 10, characterized in that measuring devices (18) for sensing the pressure and/or the volume flow of the oxygen-containing gas and for supplying corresponding actual signals to a controlling device (19) are arranged in a number of gas lines (16), it being possible for setpoint values (20) for pressure and/or volume flow in the gas lines (16) to be fed from outside to the controlling device (19) and for the regulating devices (21) to be controlled by the controlling device (19), separately from one another in each case, in dependence on a setpoint/actual-value comparison.

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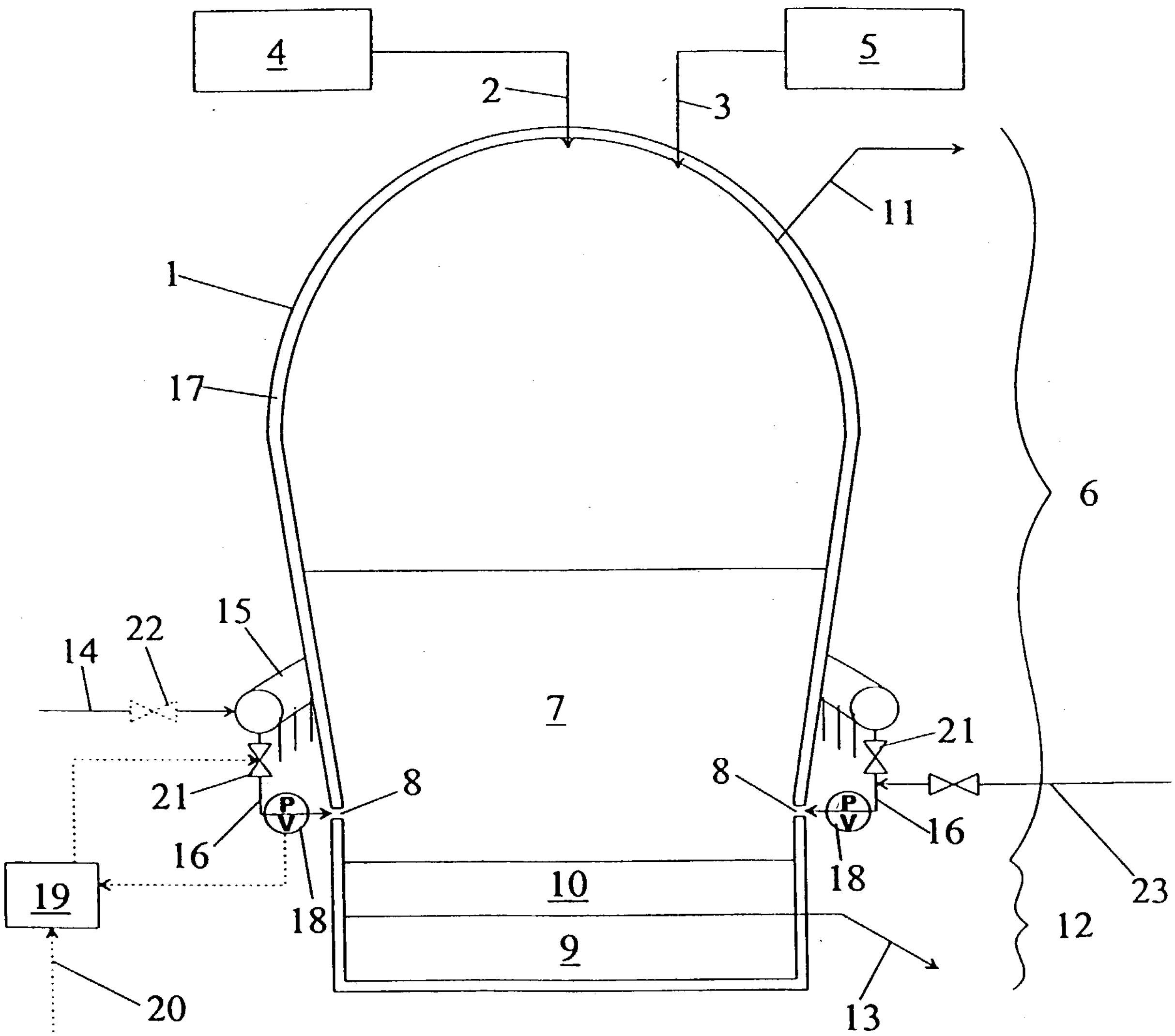
Abstract

The invention relates to a method of operating a fusion gasifier in which iron-containing charge materials are fused, with the addition of solid carbon carriers and the supply of an oxygen-containing gas - via a multiplicity of oxygen nozzles distributed around the circumference of the fusion gasifier - in a fixed bed formed from the solid carbon carriers and to form liquid pig iron or a primary steel product with the simultaneous formation of a CO- and H_2-containing reduction gas, the oxygen-containing gas being passed via gas lines to the oxygen nozzles, from where the oxygen-containing gas is blown into the fixed bed, the supply of the oxygen-containing gas being individually regulated in a number of gas lines and a prescribed volume flow of the oxygen-containing gas being set.

With the present invention, damage to oxygen nozzles can be prevented and a uniform oxygen or energy input into the fusion gasifier can be ensured.

Fig. 1:



UNITED STATES OF AMERICA COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION	OFGS FILE NO. P/3240-67

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD OF OPERATING A FUSION GASIFIER

the specification of which is attached hereto, unless the following box is checked:

☒ was filed on 20 July 2000 as United States patent Application Number or PCT International patent application number PCT/EP00/06930 and was amended on 7 June 2001 (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate or United States provisional application(s) listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign or Provisional Application(s)

COUNTRY	APPLICATION NUMBER	DATE OF FILING *(day, month, year)*	PRIORITY CLAIMED UNDER 35 U.S.C. 119
Austria	A 1455/99	24 August 1999	YES X NO ___
			YES ___ NO ___
			YES ___ NO ___

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

UNITED STATES APPLICATION NUMBER	DATE OF FILING *(day, month, year)*	STATUS *(patented, pending, abandoned)*

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

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COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. 119
			YES ___ NO ___
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			YES ___ NO ___
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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